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By making imaginary exponential substitutions, or putting $\theta = 2\phi + \alpha$ and expanding, we find

$$\begin{aligned} I_6 &= \frac{3a^2(k^2+4)^3}{512\mathrm{k}^2}[\sin(2\theta+2\alpha) - 8\sin(\theta+\alpha) + 6\theta + \tfrac{1}{3}\sin(3\theta+\alpha) \\ &\qquad + \sin(\theta+3\alpha) - 2\sin 2\theta - 4\theta\cos 2\alpha + 6\sin(\theta-\alpha)]_{-\alpha}^{\alpha} \\ &= \frac{3a^2(k^2+4)^3}{128k^2}[\tfrac{14}{3}\sin\alpha\cos^3\alpha - \tfrac{17}{3}\sin\alpha\cos\alpha + \alpha(1+4\sin^2\alpha)] \\ &= \frac{a^2(k^2+4)}{128k^2}[-2k(17k^2+12) + (15k^2+12)(k^2+4)\alpha]. \end{aligned}$$

Collecting results we find, since $S = I_1 - I_2 - I_3 + I_4$,

$$\begin{aligned} S &= \alpha\left\{\frac{9a^2(k^2+4)^2}{32k^2} + \frac{3a^2(k^2+4)(5k^2+12)}{128} - \frac{a^2(k^2+4)^2(15k^2+12)}{128k^2}\right\} \\ &\qquad + \frac{a^2}{64k}\{36(k^2+4) - 48(k^2+2) - 8k^2(k^2+4) - 9k^2(k^2+4) + (17k^2+12)(k^2+4)\} \\ &= \frac{3}{2}\frac{a^2}{k} + \tfrac{3}{4}a^2\frac{k^2+4}{k^2}\alpha = \tfrac{3}{2}ah + \tfrac{3}{4}(4h^2+a^2)\sin^{-1}\frac{a}{\sqrt{4h^2+a^2}}. \end{aligned}$$

Also solved by G. W. HARTWELL and the PROPOSER.

398A. Proposed by EMMA GIBSON, Drury College.

[This problem was unnumbered in the December issue.]

Solve the differential equation

$$(x^3y^3 + x^2y^2 + xy + 1)y + (x^3y^3 - x^2y^2 - xy + 1)x\frac{dy}{dx} = 0.$$

SOLUTION BY FREDERICK WOOD, University of Wisconsin.

The equation

$$(x^3y^3 + x^2y^2 + xy + 1)y + (x^3y^3 - x^2y^2 - xy + 1)x\frac{dy}{dx} = 0$$

reduces to

$$(x^3y^3 + 1)(ydx + xdy) + (x^2y^2 + xy)(ydx - xdy) = 0$$

and finally to

$$x^2y^2(ydx + xdy) + ydx + xdy - 2x^2ydy = 0$$

from which we get

$$ydx + xdy + \frac{ydx + xdy}{x^2y^2} - \frac{2dy}{y} = 0.$$

This becomes, after integration,

$$xy - \frac{1}{xy} - 2\log y = c, \qquad \text{or} \qquad x^2y^2 - 2xy\log c'y = 1.$$

Also solved by H. POLISH, W. W. BEMAN, H. S. UHLER, ELIJAH SWIFT, HORACE OLSON, S. E. RASOR, G. KEULIGAN, H. L. AGARD, ELMER SCHUYLER, and B. J. BROWN.

QUESTIONS AND DISCUSSIONS.

EDITED BY U. G. MITCHELL, University of Kansas.

REPLIES.

24. The following facts are significant:

(1) The New England Association of Mathematics Teachers has appointed a committee "to investigate the current criticisms of high school mathematics."

(2) A committee of the Council of the American Mathematical Society has under consideration the question "whether any action is desirable on the part of the Society in the matter of the movement against mathematics in the schools."

(3) At the recent meeting in Cincinnati of the National Education Association an iconoclastic discussion on the topic: "Can algebra and geometry be reorganized so as to justify their

retention for high school pupils not likely to enter technical schools?" aroused approbation and applause. An outline of the remarks by one of the speakers was printed in a previous issue.

In view of these facts what should be done by those who believe in the value of mathematics as a general high school study?

Reply by Charles N. Moore, University of Cincinnati.

The best thing to do is to devote a little time and effort to pointing out the essential unsoundness of the arguments that have been advanced against the retention of mathematics as a required subject in the high schools. The movement against mathematics is, for the most part, confined to a group of educational theorists who feel that they must advocate something new in order to convince their readers that they are investigators. This group, however, has made up in volume of sound for what it has lacked in numbers and, in consequence, has deceived many people into thinking that it represents a widespread trend of thought.

The statement that there is at the present time much uncertainty as to the educational value of algebra and geometry will not bear examination. That the thinking public is as firmly convinced as ever of the high educational value of these subjects was conclusively shown by the answers to a questionnaire sent out recently by Professor Hancock. This questionnaire was sent to a group of the most prominent physicians, clergymen, lawyers and business men throughout the country; it was also sent to a similar group of residents of Cincinnati. In the first group 90 out of a total of 99 advocated a high school course in which mathematics was a required subject; in the second group 96 out of a total of 105 did the same thing.[1] In view of these replies it seems to the writer that the burden of proof rests upon those who wish to displace mathematics as a required subject for high school pupils.

The statement that recent investigations have thrown doubt on the disciplinary value of mathematical study is absolutely without justification. The chief disciplinary value of mathematics is in the training of the reasoning powers it affords. The writer has gone over the literature on transfer of training quite recently, and does not know of any experiments that involved training in logical reasoning. It is absurd to contend that experiments based on the marking of certain letters on a printed page or guessing the size of pieces of paper, will enable one to draw valid conclusions with regard to the training afforded by the study of mathematics.

The statement that the value of mathematics as an instrument has been greatly exaggerated, is also without foundation. As a matter of fact the majority of people do not realize the wide extent of the applications of mathematics. The writer is continually meeting people who are deploring their lack of mathematical training because their deficiency in this respect renders it difficult or impossible to pursue some particular study or calling in which they are interested. In a recent article in *Science*,[2] Professor S. G. Barton pointed out the fact that in

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[1] For a more detailed account of Professor Hancock's investigation, *cf. School and Society*, Vol. I (1915), p. 893.

[2] Volume 40 (1914), page 697.

104 articles of the Encyclopedia Britannica, eleventh edition, use was made of the symbols of the infinitesimal calculus. Only about one fourth of these articles could be classed as dealing with pure mathematics.

The statement that the great majority of the teachers of mathematical subjects in high schools are not informed as to " the ultimate educational values " of these studies, seems much exaggerated. Undoubtedly some of these teachers are not so informed, and the reason for it lies in the deficiency of their own mathematical training. The remedy for this lies in demanding a greater amount of preliminary study of mathematics as a qualification for the teaching of that subject in the high schools.

The suggestion that mathematics might be made more cultural by introducing purely descriptive courses in this subject, is in line with the effort in certain quarters to convert our high schools into kindergartens for students of high school age. The idea that mathematics could be " interpreted " to a student that never had a mathematical idea in his head, would be amusing if it were not advocated as a serious proposal.

DISCUSSIONS.

RELATING TO THE " SIMSON LINE " OR " WALLACE LINE."

By Roger A. Johnson, Western Reserve University.

(Cf. statement in this Monthly for June, 1915, p. 201, problem No. 467.)

It is a well-known theorem that the feet of the perpendiculars from a point to the sides of a triangle are collinear if and only if the point lies on the circumscribed circle of the triangle. This theorem has always been known as Simson's, and the line as Simson's line, until recent times, when an attempt has been made to replace Simson's name by that of Wallace. See, for instance, this Monthly, June, 1915, p. 201, problem 467. The purpose of this note is to submit the proposition that the name "Simson Line" should be retained. It would be desirable, perhaps, to have the views of readers of the Monthly on the matter.

Let us first determine the facts. Some thirty years ago, the inquiry was made as to where in Simson's works the theorem in question was to be found. Search was made, especially by that able investigator J. S. Mackay of Edinburgh, who read all known writings of Simson, without finding an allusion to the theorem. Further investigation persuaded him that the fact was discovered by one William Wallace about 1798; it seems to have appeared in print for the first time in that year, in Leybourn's Mathematical Repository.[1] Mackay also[2] traces the source of the erroneous ascription to Simson. Early in the century, Servois[3] cites the theorem, introducing it in the following words, " le théorème suivant, qui est, je crois, de Simson." A little later, Poncelet in his " Propriétés Projectives," 468, reproduced this statement without the qualification, and his authority was evidently suf-

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[1] Cf. Muir, *Proceedings of the Edinburgh Math. Society*, Vol. 3, p. 104.

[2] Mackay, *Proceedings of the Edinburgh Math. Society*, Vol. 9, pp. 83–91.

[3] Gergonne's *Annales de Math.*, Vol. IV, p. 250.